

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: September 30, 2010

Certificate Number: 2417.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Electrical – DC & Low Frequency

Parameter/Equipment	Range	Best Uncertainty ^{2, 3, 4, 5} (±)	Comments
DC Voltage – Generate	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	10 µV/V + 0.8 µV 9.3 µV/V + 1.2 µV 9.3 µV/V + 4.0 µV 9.3 µV/V + 8 µV 10 µV/V + 0.1 mV 13 µV/V + 0.6 mV	Reference calibrator and precision DMM
DC Voltage – Measure	(10 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	7.8 µV/V + 3.7 µV 6.5 µV/V + 0.38 µV 6.5 µV/V + 0.13 µV 8.7 µV/V + 0.4 µV 8.9 µV/V + 0.2 µV + 12 µV/V (V _{IN} /1000) ²	Precision DMM
DC High Volt	(1 to 2) kV (2 to 20) kV (20 to 50) kV (50 to 100) kV	0.05 % + 0.02 % 0.05 % + 0.02 % 2.3 % 2.3 %	HV divider and DMM

Parameter/Range	Frequency	Best Uncertainty ^{2,3,4,5} (\pm)	Comments
AC Voltage – Generate			
(0.22 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.069 % + 5.2 μ V 0.024 % + 5.2 μ V 0.012 % + 5.2 μ V 0.042 % + 5.2 μ V 0.1 % + 8.1 μ V 0.12 % + 15 μ V 0.19 % + 29 μ V 0.39 % + 29 μ V	Reference calibrator and precision DMM
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.069 % + 5.8 μ V 0.024 % + 5.8 μ V 0.012 % + 5.8 μ V 0.043 % + 2.9 μ V 0.1 % + 8.1 μ V 0.12 % + 14 μ V 0.19 % + 29 μ V 0.39 % + 29 μ V	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.069 % + 15 μ V 0.024 % + 9.2 μ V 0.012 % + 9.2 μ V 0.037 % + 9.2 μ V 0.1 % + 29 μ V 0.12 % + 29 μ V 0.19 % + 40 μ V 0.39 % + 92 μ V	
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.069 % + 98 μ V 0.018 % + 28 μ V 86 μ V/V + 6.9 μ V 0.017 % + 18 μ V 0.029 % + 81 μ V 0.05 % + 0.15 mV 0.12 % + 0.4 mV 0.25 % + 1 mV	

Parameter/Range	Frequency	Best Uncertainty ^{2,3,4,5} (\pm)	Comments
AC Voltage – Generate (cont)			
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.069 % + 1 mV 0.018 % + 0.3 mV 86 μ V/V + 69 μ V 0.014 % + 0.2 mV 0.029 % + 0.4 mV 0.058 % + 1.7 mV 0.14 % + 4.9 mV 0.31 % + 9.8 mV	Reference calibrator and precision DMM
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) kHz	0.069 % + 9.9 mV 0.018 % + 2.9 mV 0.01 % + 0.9 mV 0.025 % + 4 mV 0.058 % + 9.2 mV 0.17 % + 0.1 V 0.54 % + 0.1 V 1.3 % + 0.2 V	
(220 to 1100) V	15 Hz to 50 Hz 50 Hz to 1 kHz	0.046 % + 16 μ V 0.01 % + 4 mV	
AC Voltage – Measure			
(1 to 10) mV	(1 Hz to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.035 % + 2 μ V 0.023 % + 2 μ V 0.035 % + 3.0 μ V 0.1 % + 3.0 μ V 0.57 % + 3.0 μ V	Precision DMM
(10 to 100) mV	(1 Hz to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	90 μ V/V + 2 μ V 80 μ V/V + 3 μ V 0.016 % + 3 μ V 0.035 % + 3 μ V 0.09 % + 3 μ V	
(0.1 to 1) V	(1 Hz to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	86 μ V/V + 40 μ V 80 μ V/V + 30 μ V 0.016 % + 30 μ V 0.035 % + 30 μ V 0.09 % + 30 μ V	
(1 to 10) V	(1 Hz to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	86 μ V/V + 0.4 mV 80 μ V/V + 0.3 mV 0.016 % + 0.3 mV 0.035 % + 0.3 mV 0.09 % + 0.3 mV	

Parameter/Range	Frequency	Best Uncertainty ^{2,3,4,5} (\pm)	Comments
AC Voltage – Measure (cont)			
(10 to 100) V	(1 Hz to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.023 % + 4 mV 0.023 % + 3 mV 0.023 % + 2.3 mV 0.041 % + 3 mV 0.14 % + 3 mV	Precision DMM
(100 to 700) V	(1 Hz to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.046 % + 50 mV 0.046 % + 16 mV 0.069 % + 14 mV 0.14 % + 21 mV 0.34 % + 21 mV	
(0.7 to 100) kV	50 Hz to 1 kHz	23 mV/V	
(0.0 to 2) kV	(20 to 100) Hz	0.08 % + 0.12 %	HV Divider
(0.0 to 2) kV	(100 to 400) Hz	0.52 % + 0.23 %	
(2 to 20) kV	(20 to 100) Hz	0.23 % + 0.12 %	

Parameter/Equipment	Range	Best Uncertainty ^{2,3,5} (\pm)	Comments
DC Current – Generate	(0 to 220) μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA	69 μ A/A + 11 nA 69 μ A/A + 11 nA 69 μ A/A + 0.11 μ A 80 μ A/A + 1.1 μ A	Reference calibrator Add 200 I ² μ A/A for I > 100 mA
	220 mA to 2.2 A	0.01 % + 34 μ A	Add 10 I ² μ A/A for I > 1 A reference calibrator
	(2.2 to 11) A (11 to 20) A (20 to 100) A	0.06 % + 0.39 mA 0.12 % + 0.9 mA 0.27 %	Calibrator, Precision shunt & DMM
	(100 to 550) A (550 to 1000) A	0.28 % + 0.58 A 0.31 % + 0.58 A	HI current amp with multi-turn coil
DC Current – Measure	(0 to 100) nA 100 nA to 1 μ A (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA	34 μ A/A + 40 pA 24 μ A/A + 40 pA 24 μ A/A + 0.1 nA 24 μ A/A + 0.8 nA 24 μ A/A + 5 nA	Precision DMM

Parameter/Equipment	Range	Best Uncertainty ^{2,3,5} (\pm)	Comments
DC Current – Measure (cont)	(1 to 10) mA (10 to 100) mA 100 mA to 1 A	24 μ A/A + 50 nA 39 μ A/A + 0.5 μ A 0.012 % + 10 μ A	Precision DMM
	(1 to 10) A (10 to 100) A (100 to 300) A (300 to 700) A (700 to 1000) A	0.012 % + 0.23 mA 0.057 % + 2.3 mA 0.11 % + 0.23 mA 3.4 % 5.7 %	Precision shunt

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (\pm)	Comments
AC Current – Generate			
(9 to 220) μ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.07 % + 25 nA 0.035 % + 20 nA 0.014 % + 16 nA 0.06 % + 40 nA 0.16 % + 80 nA	Reference calibrator
220 μ A to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.08 % + 40 nA 0.04 % + 35 nA 0.01 % + 35 nA 0.07 % + 0.4 μ A 0.18 % + 0.8 μ A	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.08 % + 0.4 μ A 0.04 % + 0.35 μ A 0.02 % + 0.35 μ A 0.07 % + 4 μ A 0.18 % + 8 μ A	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.08 % + 4 μ A 0.04 % + 3.5 μ A 0.02 % + 3.5 μ A 0.07 % + 40 μ A 0.18 % + 80 μ A	
220 mA to 2.2 A	(20 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.06 % + 35 μ A 0.07 % + 80 μ A 0.09 % + 0.16 mA	
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.1 % + 2 mA 0.1 % + 2 mA 3 % + 2 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.2 % + 5 mA 0.2 % + 5 mA 3 % + 5 mA	

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (\pm)	Comments
AC Current – Generate (cont)			
(20.5 to 550) A (550 to 1000) A	(45 to 400) Hz (45 to 400) Hz	0.29 % + 0.58 A 0.32 % + 0.58 A	Multi-turn coil
AC Current – Measure			
(5 to 100) μ A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz	0.46 % + 0.03 μ A 0.17 % + 0.03 μ A 0.07 % + 0.03 μ A 0.07 % + 0.03 μ A	Precision DMM
100 μ A to 1 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 100) kHz	0.5 % + 0.2 μ A 0.17 % + 0.2 μ A 0.07 % + 0.2 μ A 0.04 % + 0.2 μ A 0.07 % + 0.2 μ A 0.63 % + 0.2 μ A	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 100) kHz	0.46 % + 2 μ A 0.17 % + 2 μ A 0.07 % + 2 μ A 0.04 % + 2 μ A 0.07 % + 0.2 μ A 0.63 % + 0.2 μ A	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 100) kHz	0.46 % + 20 μ A 0.17 % + 20 μ A 0.07 % + 20 μ A 0.04 % + 20 μ A 0.07 % + 0.2 μ A 0.63 % + 0.2 μ A	
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 0.2 mA 0.18 % + 0.2 mA 0.09 % + 0.2 mA 0.12 % + 0.2 mA	
20 mA to 100 A	(5 to 20) kHz (20 to 50) kHz	0.35 % 1 %	
(100 to 700) A	10 Hz to 1 kHz (42 to 62) Hz (62 to 440) Hz	0.12 % 3.5 % 5.7 %	Wideband shunt/with Precision DMM

Parameter/Equipment	Range	Best Uncertainty ^{2,3,5} (\pm)	Comments
Resistance – Generate Fixed Points	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M 10 M Ω 19 M Ω 100 M Ω (100 to 110) M Ω (110 to 330) M Ω 330 M Ω to 1 G Ω	57 $\mu\Omega/\Omega$ 0.013 % 0.013 % 38 $\mu\Omega/\Omega$ 36 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 17 $\mu\Omega/\Omega$ 17 $\mu\Omega/\Omega$ 16 $\mu\Omega/\Omega$ 16 $\mu\Omega/\Omega$ 18 $\mu\Omega/\Omega$ 18 $\mu\Omega/\Omega$ 26 $\mu\Omega/\Omega$ 27 $\mu\Omega/\Omega$ 53 $\mu\Omega/\Omega$ 63 $\mu\Omega/\Omega$ 0.015 % 0.13 % + 1 Ω 0.16 % + 11 Ω 0.16 % + 115 Ω	Reference calibrator
Resistance – Measure	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω 100 M Ω to 1 G Ω	15 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 12 $\mu\Omega/\Omega$ + 500 $\mu\Omega$ 10 m Ω /k Ω + 0.5 m Ω 10 m Ω /k Ω + 5 m Ω 10 m Ω /k Ω + 50 m Ω 15 Ω /M Ω + 2 Ω 50 Ω /M Ω + 100 Ω 500 Ω /M Ω + 1 k Ω 0.5 % + 10 k Ω	Precision DMM

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (\pm)	Comments
Capacitance – Generate			
(0.19 to 0.4) nF	10 Hz to 10 kHz	0.5 % + 0.01 nF	Reference calibrator
(0.4 to 1.1) nF		0.5 % + 0.01 nF	
(1.1 to 3.3) nF		0.5 % + 0.01 nF	
(3.3 to 11) nF		0.25 % + 0.01 nF	
(11 to 33) nF		0.25 % + 0.1 nF	
(33 to 110) nF		0.25 % + 0.1 nF	
(110 to 330) nF		0.25 % + 0.3 nF	
330 nF to 1.1 μ F	(10 to 600) Hz	0.25 % + 1 nF	
(1.1 to 3.3) μ F	(10 to 300) Hz	0.25 % + 3 nF	
(3.3 to 11) μ F	(10 to 150) Hz	0.25 % + 10 nF	
(11 to 33) μ F	(10 to 120) Hz	0.40 % + 30 nF	
(33 to 110) μ F	(10 to 80) Hz	0.45 % + 100 nF	
(110 to 330) μ F	(0 to 50) Hz	0.45 % + 300 nF	
330 μ F to 1.1 mF	(0 to 20) Hz	0.45 % + 1 nF	
(1.1 to 3.3) mF	(0 to 6) Hz	0.45 % + 3 nF	
(3.3 to 11) mF	(0 to 2) Hz	0.45 % + 10 nF	
(11 to 33) mF	(0 to 0.6) Hz	0.75 % + 30 nF	
(33 to 110) mF	(0 to 0.2) Hz	1.1 % + 0.1 μ F	

Parameter/Range	Frequency	Best Uncertainty ^{2, 3, 5} (\pm)	Comments
Capacitance – Measure			
Up to 1 pF	100 Hz	0.3 % + 1 fF + 3 cts	Multi-frequency LCR meter, dissipation factor < 0.1 cts: Counts of LSD
	120 Hz	0.3 % + 1 fF + 3 cts	
	200 Hz	0.3 % + 1 fF + 2 cts	
	400 Hz	0.3 % + 1 fF + 6 cts	
	1 kHz	0.3 % + 1 fF + 3 cts	
	2 kHz	0.3 % + 1 fF + 2 cts	
	4 kHz	0.3 % + 1 fF + 6 cts	
	10 kHz	0.3 % + 1 fF + 3 cts	
	20 kHz	0.3 % + 1 fF + 2 cts	
	40 kHz	0.3 % + 1 fF + 6 cts	
	100 kHz	0.3 % + 1 fF + 3 cts	
(1 to 10) pF	100 Hz	0.3 % + 1 fF + 3 cts	
	120 Hz	0.3 % + 1 fF + 3 cts	
	200 Hz	0.3 % + 1 fF + 2 cts	
	400 Hz	0.3 % + 1 fF + 6 cts	
	1 kHz	0.3 % + 1 fF + 3 cts	
	2 kHz	0.3 % + 2 cts	
	4 kHz	0.28 % + 6 cts	
	10 kHz	0.28 % + 3 cts	
	20 kHz	0.28 % + 2 cts	
	40 kHz	0.28 % + 6 cts	
	100 kHz	0.28 % + 3 cts	
(10 to 100) pF	100 Hz	0.3 % + 3 cts	
	120 Hz	0.3 % + 3 cts	
	200 Hz	0.3 % + 2 cts	
	400 Hz	0.28 % + 6 cts	
	1 kHz	0.28 % + 3 cts	
	2 kHz	0.28 % + 2 cts	
	4 kHz	0.28 % + 6 cts	
	10 kHz	0.28 % + 3 cts	
	20 kHz	0.28 % + 2 cts	
	40 kHz	0.28 % + 6 cts	
	100 kHz	0.28 % + 3 cts	

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (\pm)	Comments
Capacitance – Measure (cont)	Fixed Points		
(10 to 100) pF	100 Hz	0.28 % + 3 cts	Multi-frequency LCR meter, dissipation factor < 0.1 cts: Counts of LSD
	120 Hz	0.28 % + 3 cts	
	200 Hz	0.28 % + 2 cts	
	400 Hz	0.28 % + 6 cts	
	1 kHz	0.28 % + 3 cts	
	2 kHz	0.28 % + 2 cts	
	4 kHz	0.28 % + 6 cts	
	10 kHz	0.28 % + 3 cts	
	20 kHz	0.28 % + 2 cts	
	40 kHz	0.28 % + 6 cts	
	100 kHz	0.28% + 3 cts	
	100 pF to 10 nF	100 Hz	
120 Hz		0.28 % + 3 cts	
200 Hz		0.28 % + 2 cts	
400 Hz		0.28 % + 6 cts	
1 kHz		0.28 % + 3 cts	
2 kHz		0.28 % + 2 cts	
4 kHz		0.28 % + 6 cts	
10 kHz		0.28 % + 3 cts	
20 kHz		0.28 % + 2 cts	
40 kHz		0.7 % + 1 cts	
100 kHz		0.3 % + 1 cts	
100 nF to 1 μ F		100 Hz	0.1 % + 3 cts
	120 Hz	0.1 % + 3 cts	
	200 Hz	0.1 % + 2 cts	
	400 Hz	0.1 % + 6 cts	
	1 kHz	0.1 % + 3 cts	
	2 kHz	0.1 % + 2 cts	
	4 kHz	0.6 % + 1 cts	
	10 kHz	0.3 % + 1 cts	
	20 kHz	0.2 % + 1 cts	
	40 kHz	0.6 % + 1 cts	
	100 kHz	0.3 % + 1 cts	

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (\pm)	Comments	
Capacitance – Measure (cont)				
(1 to 10) μ F	100 Hz	0.1 % + 3 cts	Multi-frequency LCR mete, dissipation factor < 0.1 cts: Counts of LSD	
	120 Hz	0.1 % + 3 cts		
	200 Hz	0.1 % + 2 cts		
	400 Hz	0.6 % + 1 cts		
	1 kHz	0.3 % + 1 cts		
	2 kHz	0.2 % + 1 cts		
	4 kHz	0.6 % + 1 cts		
	10 kHz	0.3 % + 1 cts		
	20 kHz	0.2 % + 1 cts		
	40 kHz	0.3 % + 1 cts		
	100 kHz	0.3 % + 1 cts		
	(10 to 100) μ F	100 Hz		0.1 % + 3 cts
		120 Hz		0.1 % + 3 cts
200 Hz		0.1 % + 2 cts		
400 Hz		0.6 % + 1 cts		
1 kHz		0.3 % + 1 cts		
2 kHz		0.2 % + 1 cts		
4 kHz		0.6 % + 1 cts		
10 kHz		0.3 % + 1 cts		
20 kHz		0.2 % + 1 cts		
40 kHz		3 % + 1 cts		
100 kHz		3 % + 1 cts		
100 μ F to 1 mF		100 Hz	0.3 % + 1 cts	
		120 Hz	0.3 % + 1 cts	
	200 Hz	0.2 % + 1 cts		
	400 Hz	1 % + 1 cts		
	1 kHz	1 % + 1 cts		
	2 kHz	1 % + 1 cts		
	4 kHz	3 % + 1 cts		
	10 kHz	3 % + 1 cts		
	20 kHz	3 % + 1 cts		
	(1 to 10) mF	100 Hz	1 % + 1 cts	
120 Hz		1 % + 1 cts		
200 Hz		1 % + 1 cts		
400 Hz		3 % + 1 cts		
1 kHz		3 % + 1 cts		
2 kHz		3 % + 1 cts		

Parameter/Equipment	Frequency	Best Uncertainty ^{2, 3, 5} (\pm)	Comments
Capacitance – Measure (cont) (10 to 100) mF 100 mF to 1 F	100 Hz 120 Hz 200 Hz 400 Hz 1 kHz 2 kHz 100 Hz 120 Hz 200 Hz	3 % + 1 cts 3 % + 1 cts 3 % + 1 cts 5 % + 1 cts 10 % + 1 cts 10 % + 1 cts 10 % + 1 cts 10 % + 1 cts 10 % + 1 cts	Multi-frequency LCR meter, dissipation factor < 0.1 cts: Counts of LSD
Inductance – Generate 1 H 10 mH 200 μ H	(0.1 to 1) kHz (0.1 to 1) kHz 10 Hz to 1 kHz	0.12 % 0.11 % 0.28 %	Standard inductors
Inductance – Measure Up to 100 nH	Fixed Points (100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz 100 kHz	1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts	Multi-frequency LCR meter, cts: Counts of LSD

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (\pm)	Comments
Inductance – Measure (cont)			
100 nH to 1 μ H	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz 100 kHz	1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 0.5 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts	Multi-frequency LCR meter, cts: Counts of LSD
(1 to 10) μ H	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz 100 kHz	1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 1 % + 0.1 nH + 5 cts 0.5 % + 0.1 nH + 5 cts 0.5 % + 0.1 nH + 5 cts 0.5 % + 0.1 nH + 5 cts 0.3 % + 3 cts 0.3 % + 3 cts 0.3 % + 3 cts 0.3 % + 3 cts	
(10 to 100) μ H	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz 100 kHz	0.5 % + 0.1 nH + 5 cts 0.5 % + 0.1 nH + 5 cts 0.5 % + 0.1 nH + 5 cts 0.3 % + 3 cts 0.3 % + 3 cts 0.3 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts	

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (\pm)	Comments
Inductance – Measure (cont)			
100 μ H to 1 mH	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz 100 kHz	0.3 % + 3 cts 0.3 % + 3 cts 0.3 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.2 % + 3 cts 0.2 % + 3 cts 0.2 % + 3 cts 0.1 % + 1 cts	Multi-frequency LCR meter, cts: Counts of LSD
(1 to 10) mH	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz 100 kHz	0.1 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.2 % + 3 cts 0.2 % + 3 cts 0.2 % + 3 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts	
(10 to 100) mH	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz 100 kHz	0.2 % + 1 cts 0.2 % + 1 cts 0.2 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts	

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (\pm)	Comments
Inductance – Measure (cont)	Fixed Points		
100 mH to 1 H	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz 100 kHz	0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 3 % + 1 cts	Multi-frequency LCR meter, cts: Counts of LSD
(1 to 10) H	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz 10 kHz 20 kHz 40 kHz	0.1 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.1 % + 3 cts 0.3 % + 3 cts 0.3 % + 3 cts 0.3 % + 3 cts	
(10 to 100) H	(100, 120) Hz 200 Hz 400 Hz 1 kHz 2 kHz 4 kHz	0.1 % + 1 cts 0.1 % + 1 cts 0.1 % + 1 cts 3 % + 1 cts 3 % + 1 cts 3 % + 1 cts	

Parameter/Equipment	Range	Best Uncertainty ^{2,3,5} (\pm)	Comments
Dissipation Factor – Measure (Df)			
1 pF to 100 μ F	(0.001 to 2) Df	3 % + 1 cts	Multi-frequency LCR meter

Parameter/Equipment	Range	Best Uncertainty ^{2,3,5} (±)	Comments
Electrical Calibration of Thermocouple Indicating Systems –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.56 °C 0.46 °C 0.41 °C 0.45 °C	Multi-product calibrator
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.41 °C 0.38 °C 0.43 °C 0.59 °C 0.98 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.59 °C 0.22 °C 0.20 °C 0.22 °C 0.27 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.33 °C 0.22 °C 0.20 °C 0.23 °C 0.29 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.40 °C 0.24 °C 0.22 °C 0.32 °C 0.48 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.44 °C 0.32 °C 0.23 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.52 °C 0.28 °C 0.25 °C 0.24 °C 0.39 °C	

Parameter/Equipment	Range	Best Uncertainty ^{2,3} (±)	Comments	
Electrical Calibration of Thermocouple Indicating Systems – (cont)				
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.67 °C 0.42 °C 0.40 °C 0.47 °C	Multi-product calibrator	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.56 °C 0.43 °C 0.44 °C 0.54 °C		
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.74 °C 0.30 °C 0.22 °C 0.20 °C		
Type U	(-200 to 0) °C (0 to 600) °C	0.65 °C 0.33 °C		
Electrical Calibration of RTD Indicators –				
Pt 395, 100 Ω	(-200 to 100) °C (100 to 630) °C (630 to 800) °C	0.08 °C 0.14 °C 0.27 °C		Multi-product calibrator
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 300) °C (300 to 630) °C	0.08 °C 0.11 °C 0.14 °C		
Pt 3916, 100 Ω	(-190 to 0.0) °C (0.0 to 260) °C (260 to 600) °C (600 to 630) °C	0.06 °C 0.08 °C 0.12 °C 0.26 °C		
Pt 385, 200 Ω	(-200 to 260) °C (260 to 400) °C (400 to 630) °C	0.06 °C 0.15 °C 0.19 °C		

Parameter/Equipment	Range	Best Uncertainty ^{2,3,5} (\pm)	Comments	
Electrical Calibration of RTD Indicators – (cont)				
Pt 385, 500 Ω	(-200 to 260) $^{\circ}\text{C}$ (260 to 600) $^{\circ}\text{C}$ (600 to 630) $^{\circ}\text{C}$	0.07 $^{\circ}\text{C}$ 0.11 $^{\circ}\text{C}$ 0.13 $^{\circ}\text{C}$	Reference calibrator	
Pt 385, 1000 Ω	(-200 to 100) $^{\circ}\text{C}$ (100 to 600) $^{\circ}\text{C}$ (600 to 630) $^{\circ}\text{C}$	0.05 $^{\circ}\text{C}$ 0.08 $^{\circ}\text{C}$ 0.27 $^{\circ}\text{C}$		
PtNi 385, 120 Ω	(-80 to 100) $^{\circ}\text{C}$ (100 to 260) $^{\circ}\text{C}$	0.09 $^{\circ}\text{C}$ 0.16 $^{\circ}\text{C}$		
Cu 427, 10 Ω	(-100 to 260) $^{\circ}\text{C}$	0.35 $^{\circ}\text{C}$		
Oscilloscopes –				
Rise Time 50 Ω load (< 2 MHz)	≤ 300 ps	(+ 0 ps / -100 ps)	Multi-product calibrator	
DC Voltage 1 M Ω Load 50 Ω Load	(0 to 130) V (0 to 6.6) V	0.058 % + 46 μV 0.29 % + 46 μV		
Square Wave 1 M Ω Load 50 Ω Load	1 mV to 130 V _{pk-pk} 1 mV to 6.6 V _{pk-pk}	0.12 % + 46 μV 0.29 % + 46 μV		
Band Width	50 kHz reference	N/A		
Flatness	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (0.6 to 1.1) GHz	1.7 % 2.3 % 4.6 % 5.7 %		
Timing	5 s, 2 s, 1 s, 0.5 s, 0.2 s, 0.1 s and 50 ms	(25 + t *1000) $\mu\text{s/s}$		t is time mark interval in seconds
	20 ms, 10 ms, 5 ms, 2 ms 1 ms and 500 ns, 200 ns 100 ns, 50 ns, 20 ns, 10 ns, 5 ns and 2 ns	2.9 $\mu\text{s/s}$		

II. Mechanical

Parameter/Equipment	Range	Best Uncertainty ^{2, 3, 5} (\pm)	Comments
Vacuum and Pressure			
Nitrogen	(-25 to 100) psi (100 to 300) psi (300 to 1999) psi	0.06 % 0.12 % 0.12 %	Pressure calibrator transducer and DM
Manometer Pressure	(0 to 20) inches H ₂ O	0.1 % + 1 cts	Manometer
Absolute	(0 to 200) inches H ₂ O (0 to 900) mmHg	0.06 % + 1 cts 0.03 %	Absolute manometer
Hydraulic	(500 to 7000) psi (0.0 to 10 000) psi	0.06 % + 0.06 psi 0.18 %	Transducer and DM
Vibration General Purpose	(5 to 9) Hz (10 to 99) Hz (100 to 1999) Hz (2 to 10) kHz	2.3 % 1.7 % 1.2 % 2.9 %	PCB quartz acceleration reference, back to back comparison method

III. Time & Frequency

Parameter/Equipment	Range	Best Uncertainty ^{2, 3} (\pm)	Comments
Frequency – Measuring Equipment	0.01 Hz to 1.1 GHz 50 kHz to 600 MHz 50 kHz to 1.1 GHz	3 μ Hz/Hz 3 μ Hz/Hz	Multi-product calibrator
Frequency – Measure	10 MHz (0 to 200) MHz (200 to 1300) MHz	1 part in 10^{11} 1 part in 10^8 1 part in 10^5	GPS receiver/ counter differential meter, modulation analyzer

IV. Thermodynamics

Parameter/Equipment	Range	Best Uncertainty ^{2,3} (±)	Comments
Infrared	(100 to 350) °C (350 to 700) °C (700 to 1000) °C	1.1 °C 2.1 °C 2.9 °C	Infrared source
Relative Humidity – Measure	(0 to 90) % RH (90 to 100) % RH	2.3 % RH 3.5 % RH	Humidity indicator
Temperature – Measuring Equipment	Ambient to 650 °C	0.9 °C	Dry wells
Temperature – Measure	(-195 to 300) °C (300 to 400) °C	0.016 °C 0.026 °C	PRT and Precision DMM

V. Chemical

Parameter/Equipment	Range	Best Uncertainty ^{2,3} (±)	Comments
pH – Generate	(4, 7, 10) pH	0.013 pH	Certified pH solutions, traceable to IUPAC/NIST pH scale.

VI. Electrical – RF & Microwave

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (±)	Comments
Power Sensor Calibration Factor (-70 to -20) dbm (-30 to 20) dbm	10 MHz to 18 GHz 10 MHz to 18 GHz	3.7 % 4.8 %	Power meter with sensors

Parameter/Range	Frequency	Best Uncertainty ^{2,3,5} (±)	Comments
Amplitude Modulation Carrier (0.15 to 10) MHz Carrier (0.15 to 10) MHz Carrier (10 to 1.3) MHz Carrier (10 to 1.3) MHz	50 Hz to 10 kHz 20 Hz to 10 kHz 50 Hz to 50 kHz 20 Hz to 100 kHz	2.9 % 3.8 % 2.0 % 3.8 %	Modulation analyzer
Frequency Modulation Carrier 150 kHz to 10 MHz Dev: up to 40 kHz Carrier 150 kHz to 10 MHz Dev: up to 40 kHz Carrier 10 MHz to 1.3 GHz Dev: up to 400 kHz Carrier 10 MHz to 1.3 GHz Dev: up to 400 kHz	20 Hz to 50 Hz 20 Hz to 10 kHz 50 Hz to 100 kHz (20 to 200) k rate	2.6 % 2.6 % 1.6 % 6.0 %	Modulation analyzer
Phase Modulation Carrier 150 kHz to 10 MHz Depth (5 to 99) % Carrier 10 MHz to 1.3 GHz Depth (5 to 99) %	20 Hz to 10 kHz 200 Hz to 20 kHz	4.8 % + 1.2 digit 3.7 % + 1.2 digit	Modulation analyzer

¹ This laboratory offers commercial and field calibration services.

² “Best Uncertainty” is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer’s device, to the environment and to influences from the circumstances of the specific calibration.

³ Field calibration service is available for all parameters and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the uncertainties achievable on a customer’s site can normally be expected to be larger than the Best Measurement Capabilities (BMC) that the accredited laboratory has been assigned as Best Uncertainty on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.

⁴ Where ranges overlap the uncertainty for the overlapping specification will be the lower of the two uncertainties.

⁵ In the statement of best uncertainty, percentages are percentages of reading, unless otherwise indicated.



THE AMERICAN ASSOCIATION FOR
LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

CENTURY LABS II CORP

Fort Wayne, IN

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005*).

Presented this 13th day of August 2008.

A handwritten signature in cursive script, reading "Peter Abney", positioned above a horizontal line.

President
For the Accreditation Council
Certificate Number 2417.01
Valid to September 30, 2010
REVISED July 15, 2010



For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.